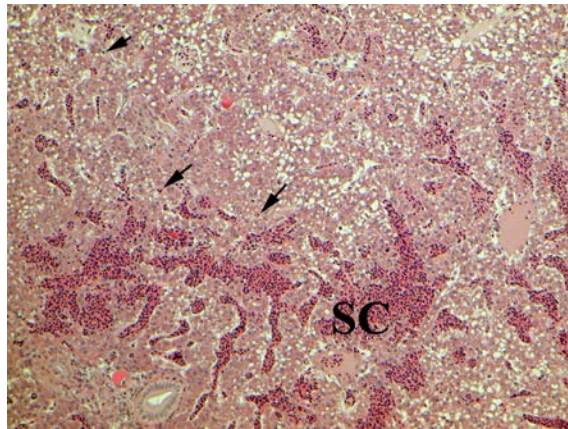
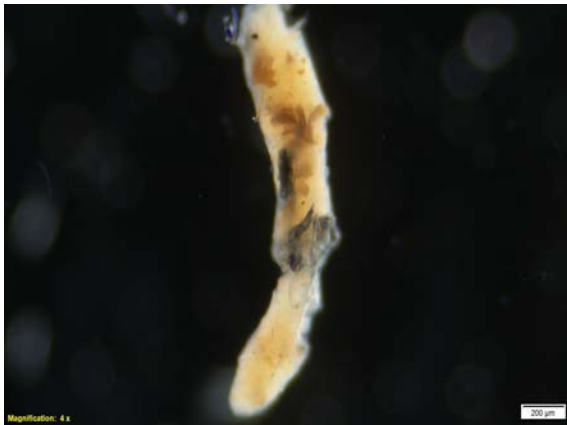
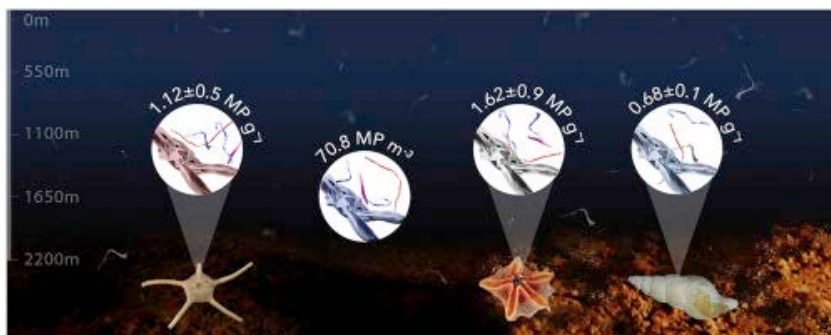


The ways in which microplastics can impact organisms in the ambient environment



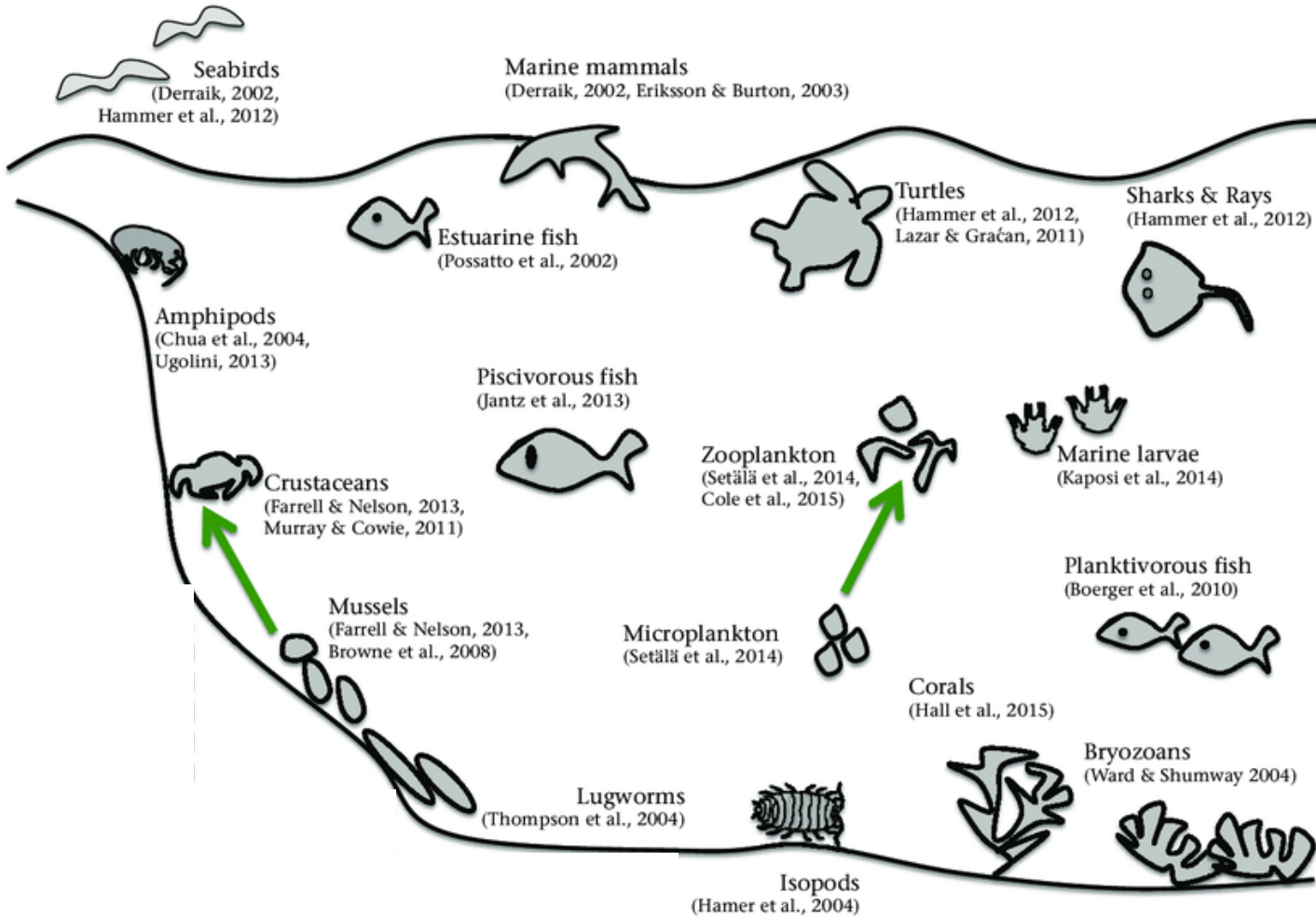
Contamination is widespread

Courtene-Jones et al., 2017 *Environ Pollut*



Peeken et al., 2018 *Nature Communications*

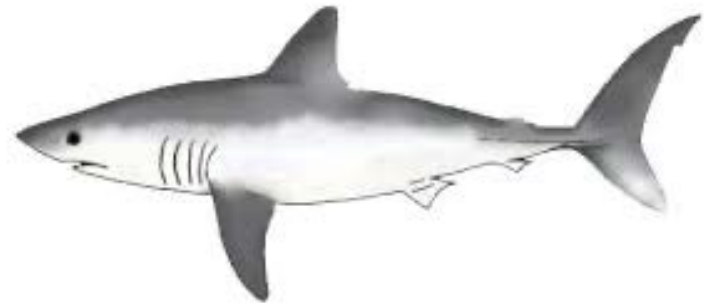
Contamination is widespread



Contamination is widespread



915 particles - Munno et al., *in review*

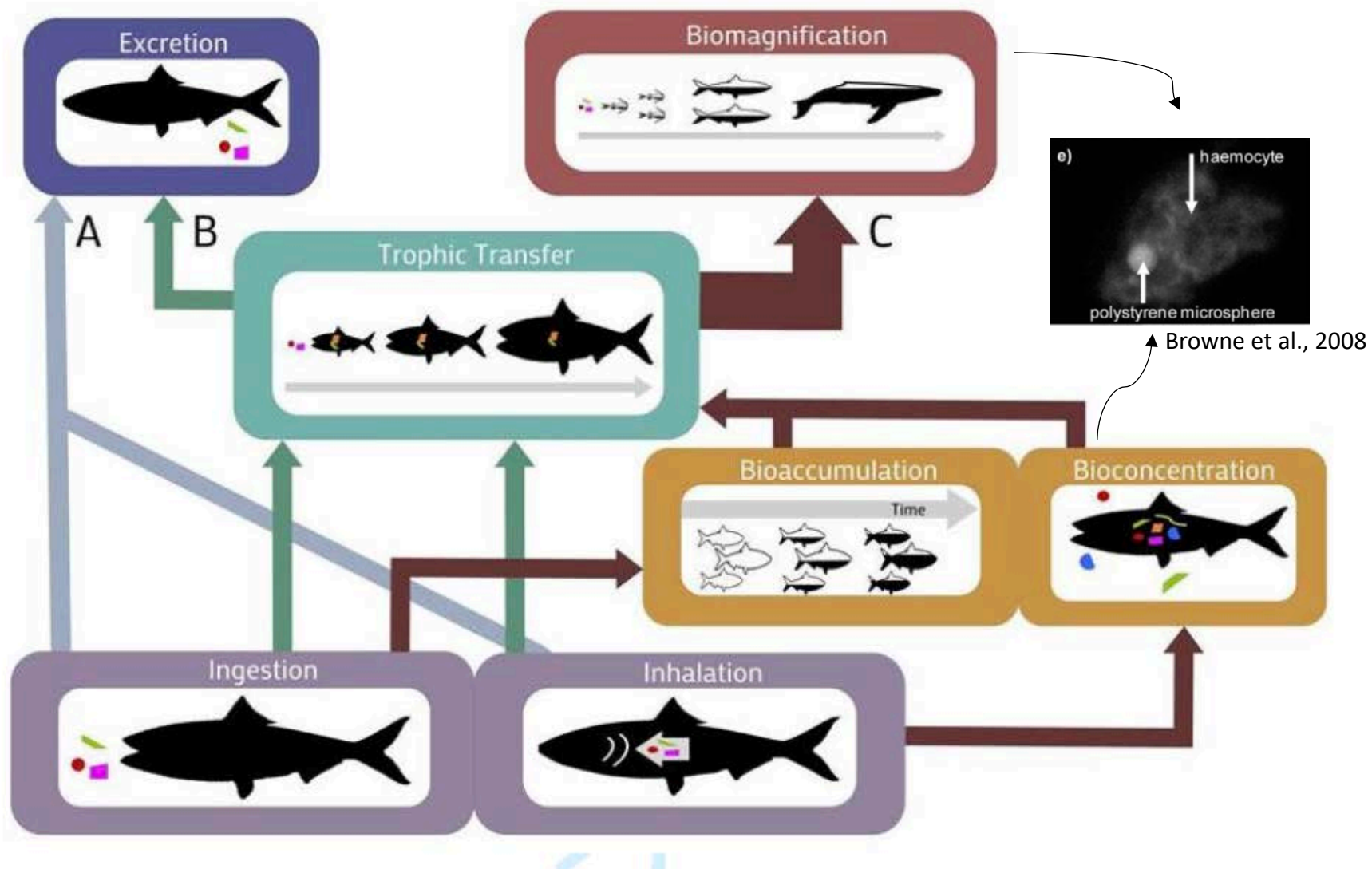


3850 particles - Maes et al., 2020

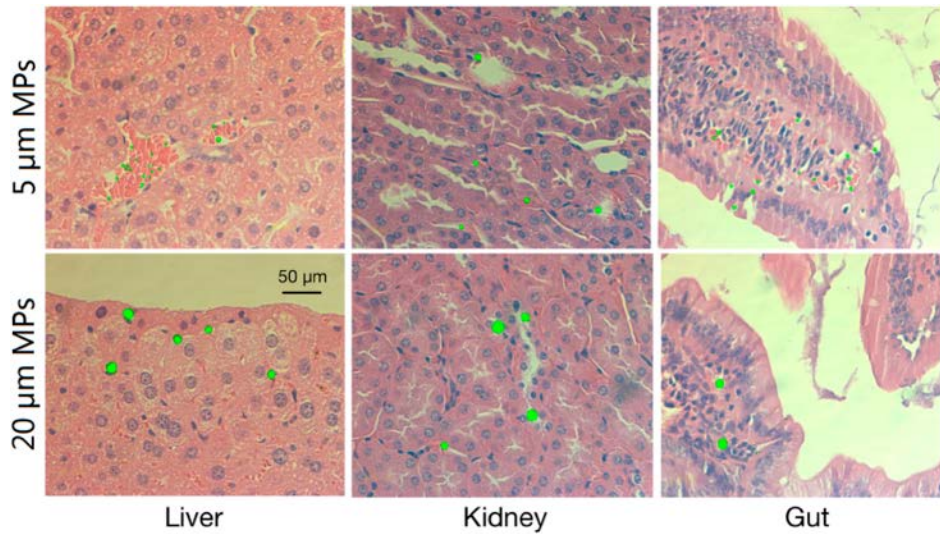
What are the effects of
microplastics in
ambient environments?



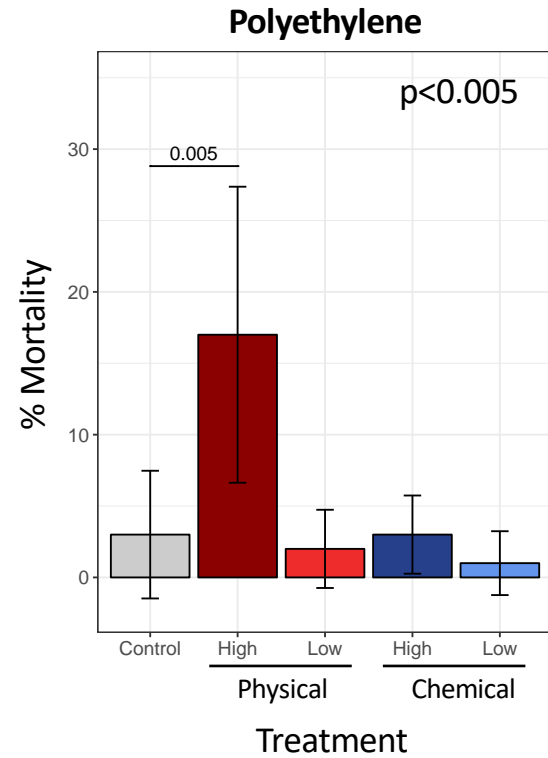
Fate of microplastics



Modes of Impact: Physical



Mice: Deng et al., 2017 *Scientific Reports*



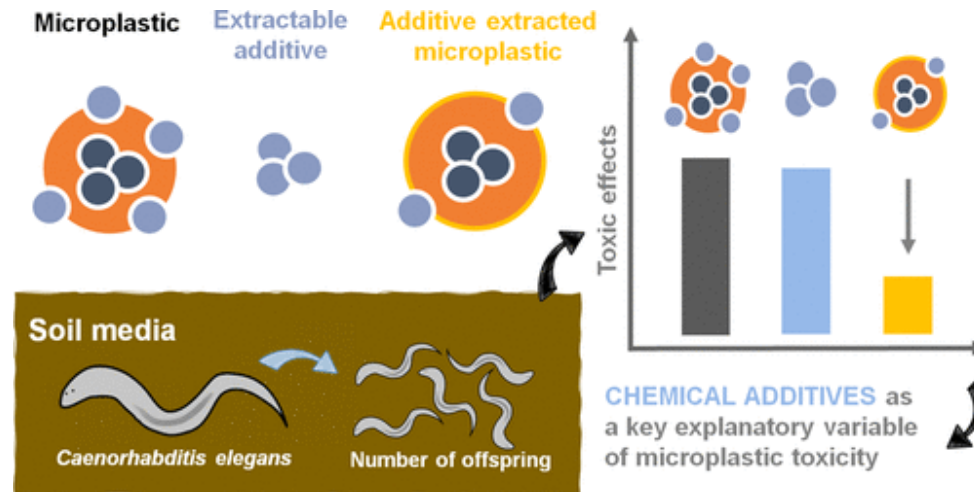
Fish: Bucci et al., *in review ES&T*

Modes of Impact: Chemical (plastic-specific)



Figure 6. Fathead minnows exposed to the leachates from the CO₂ experiments at 600 ppm a) control; b) Tire 1 ; c) Tire 2. The black bar represents 1 mm.

Kolomijeca et al., 2020 *ES&T*



Kim et al., 2020 *ES&T*

Modes of Impact: Chemical (ambient)

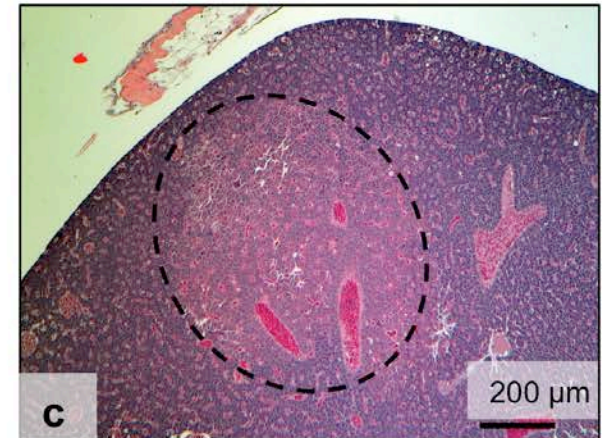
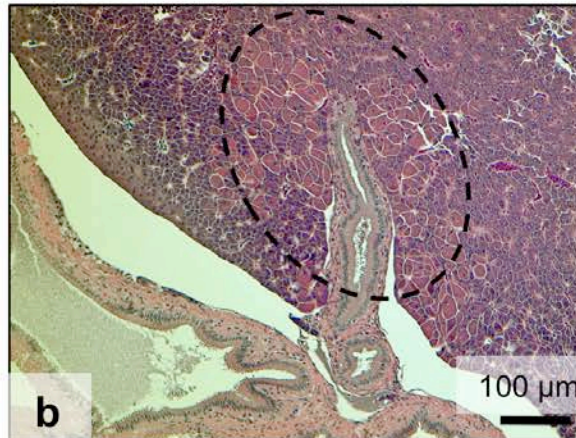
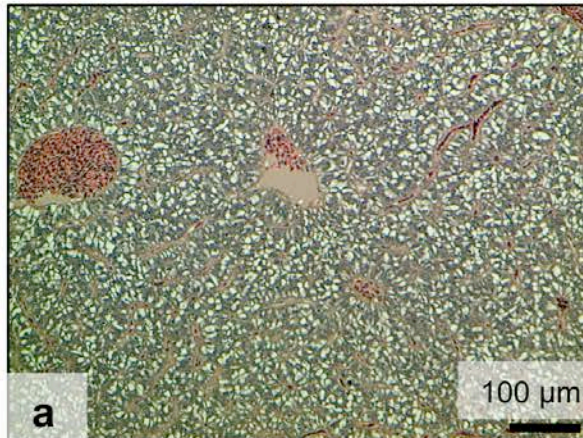
Number of deformities
(n=5, 20 fish per replicate tank)

PE	Scoliosis	Edema	Hatch	Tail	Other	Total
Control	0	0	0	0	0	0
Chem-Low	0	0	0	0	0	0
Chem-High	0	1	0	0	0	1
Phys-Low	0	0	0	0	0	0
Phys-High	0	3	0	0	0	3
PP						
Control	0	2	0	0	0	2
Chem-Low	0	0	0	0	0	0
Chem-High	0	1	0	0	0	1
Phys-Low	1	1	1	0	0	3
Phys-High	0	0	0	0	0	0

LO

Control	0	1	0	0	0	1
Chem-Low	1	4	1	1	0	7
Chem-High	0	5	0	0	1	6
Phys-Low	1	2	1	2	0	6
Phys-High	1	11	2	1	0	15

Bucci et al., *in review: ES&T*



Rochman et al., 2013, *Scientific Reports*

Specific, sensitive, and reproducible
Yet difficult to relate to ecological change

**HIGH
TOXICOLOGICAL
RELEVANCE**

Determine health and fitness of individuals
Allow extrapolation to population/community effects

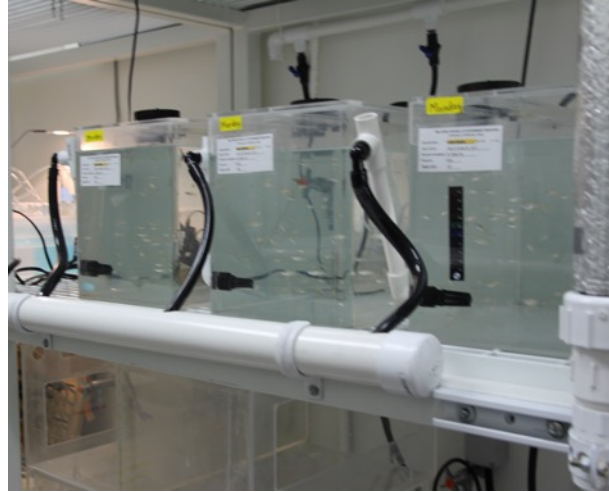
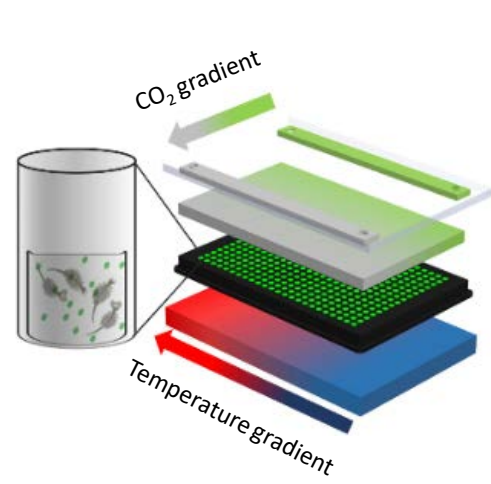
**SHORT-TERM
RESPONSE**

**LONG-TERM
RESPONSE**

HIGH

Directly indicative of ecosystem health
Yet difficult to determine, less specific AND manifest
when environmental damages have already occurred

Multiple Scales





Contents lists available at [ScienceDirect](#)

Environmental Pollution

journal homepage: www.elsevier.com/locate/envpol



Impact of polyethylene microbeads on the floating freshwater plant duckweed *Lemna minor*[☆]



Gabriela Kalčíková^{a,*}, Andreja Žgajnar Gotvajn^a, Aleš Kladnik^b, Anita Jemec^b



Contents lists available at [ScienceDirect](#)

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul



Effects of microplastics on sessile invertebrates in the eastern coast of Thailand: An approach to coastal zone conservation



Gajahin Gamage Nadeeka Thushari^{a,b}, Jayan Duminda Mahesh Senevirathna^a, Amaratne Yakunitivage^b, Suchana Chavanich^{c,*}



Contents lists available at [ScienceDirect](#)

Fish & Shellfish Immunology

journal homepage: www.elsevier.com/locate/fsi



Full length article

Effects of dietary polyvinylchloride microparticles on general health, immune status and expression of several genes related to stress in gilthead seabream (*Sparus aurata* L.)



Cristóbal Espinosa, Alberto Cuesta, María Ángeles Esteban^{*}



Contents lists available at [ScienceDirect](#)

Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul



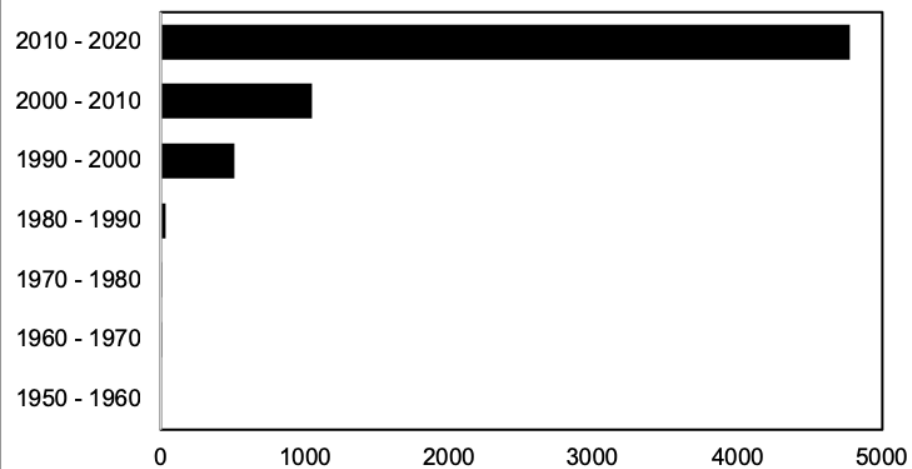
Note

Fatal ingestion of floating net debris by two sperm whales (*Physeter macrocephalus*)

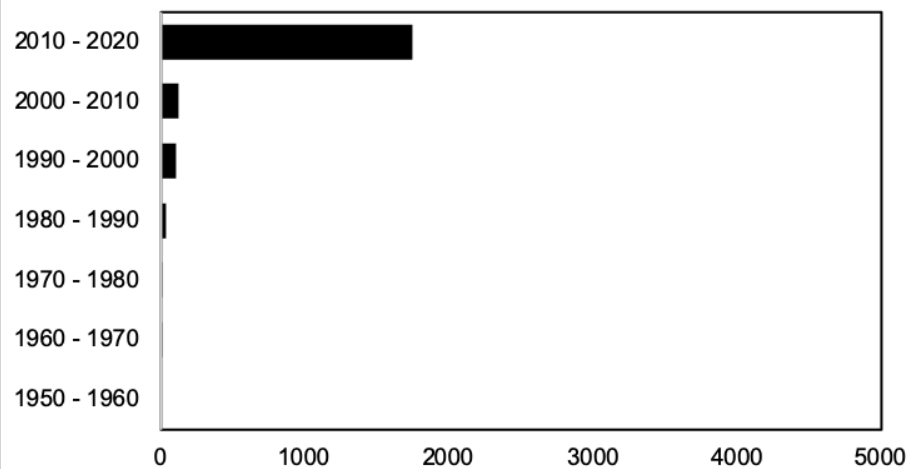
Jeff K. Jacobsen^{a,*}, Liam Massey^b, Frances Gulland^c



of Papers with: Plastic and (pollution or debris)



of Papers with: microplastic



Ecological Applications, 0(0), 2020, e02044
© 2019 by the Ecological Society of America

What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review

K. BUCCI, M. TULIO, AND C. M. ROCHMAN¹

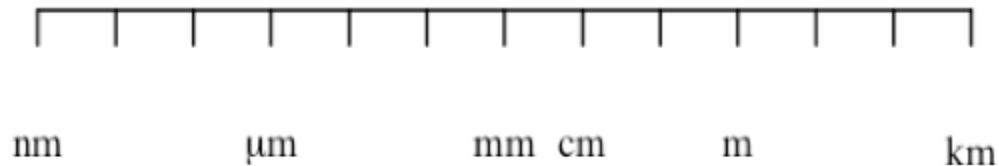
Department of Ecology and Evolutionary Biology, University of Toronto-St. George Campus, Toronto, Ontario M5S 3B2 Canada

Citation: Bucci, K., M. Tulio, C. M. Rochman. 2019. What is known and unknown about the effects of plastic pollution: A meta-analysis and systematic review. *Ecological Applications* 00(00):e02044. 10.1002/eap.2044

Levels of biological organization

Assemblage	14
Species	13
Population	12
Organism	11
Organ System	10
Organ	9
Tissue	8
Cell	7
Organelle	6
Molecular Assemblies	5
Macromolecules	4
Small Molecules	3
Atoms	2
Subatomic Particles	1

Impacts described were grouped by size of debris and level of biological organization.



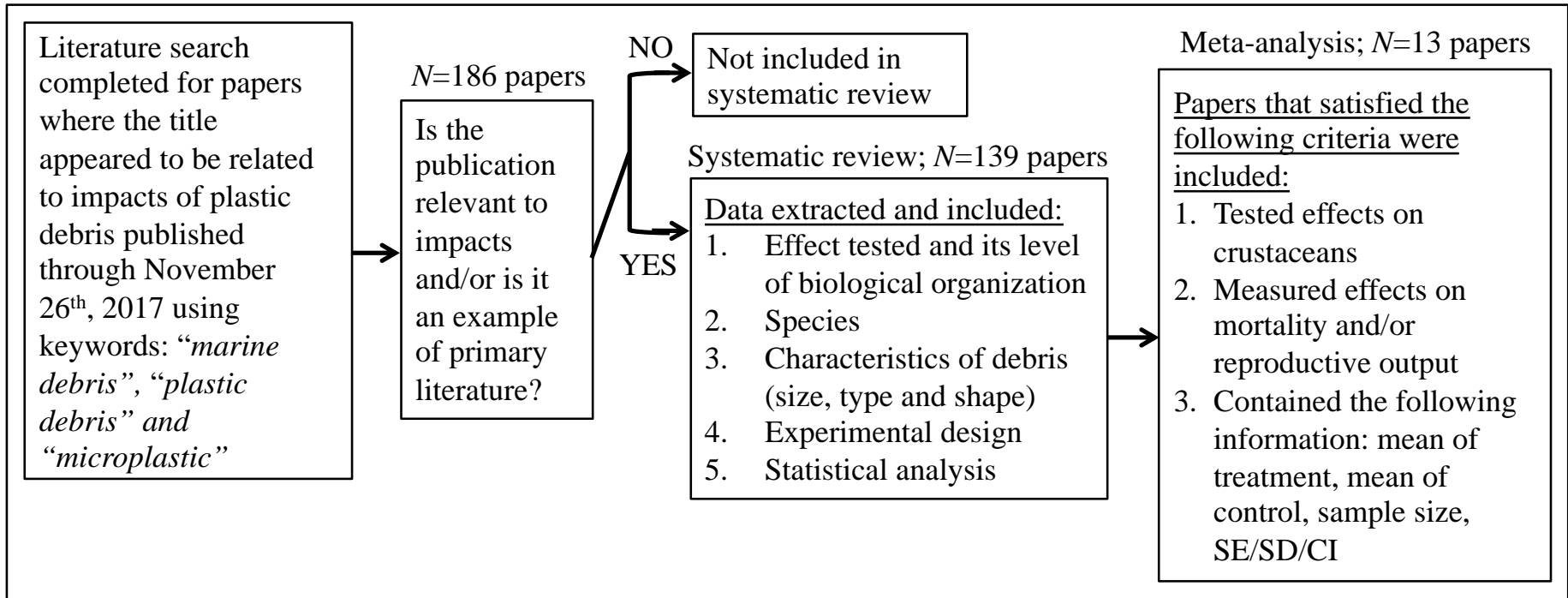
Update with the literature through November 26th, 2017



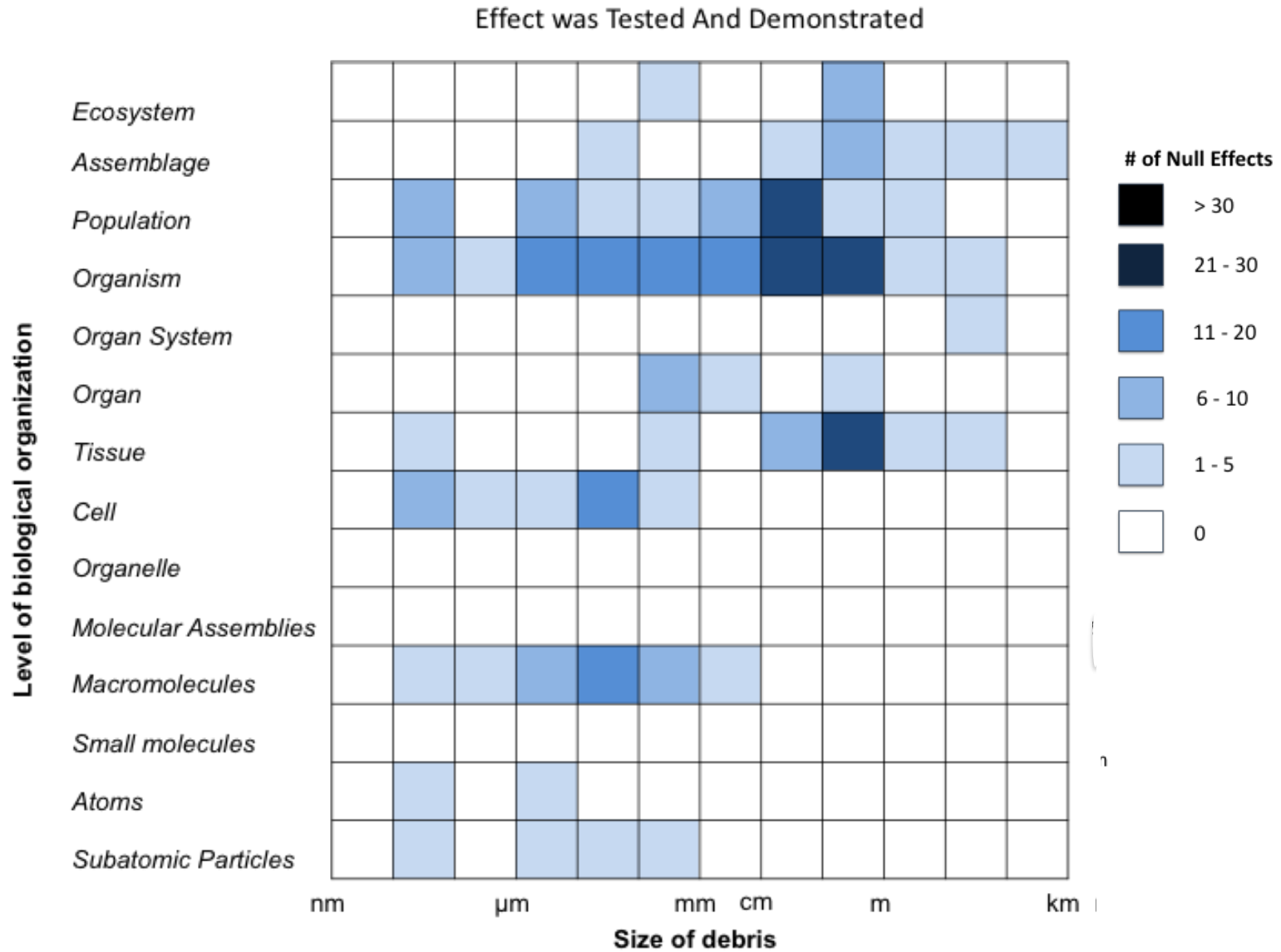
Kennedy Bucci



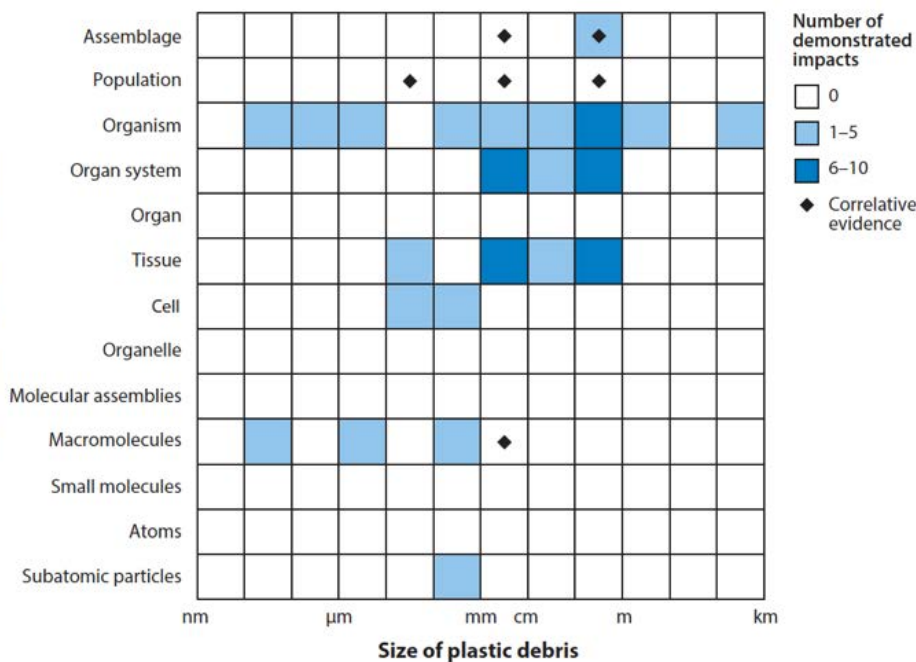
Matthew Tulio



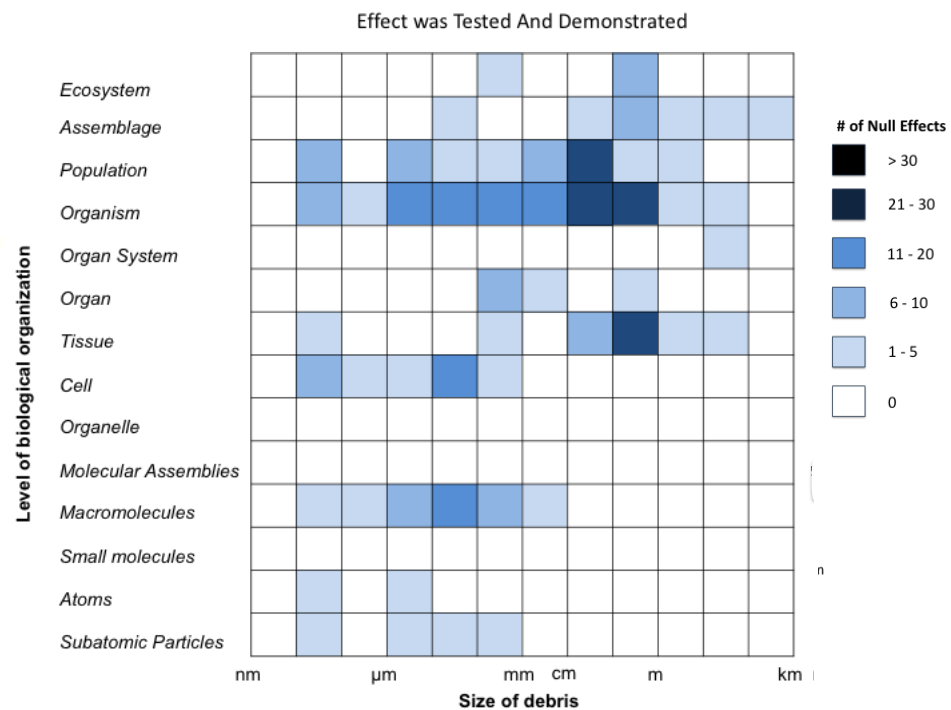
The Evidence Demonstrating Impacts to aquatic biota is Growing



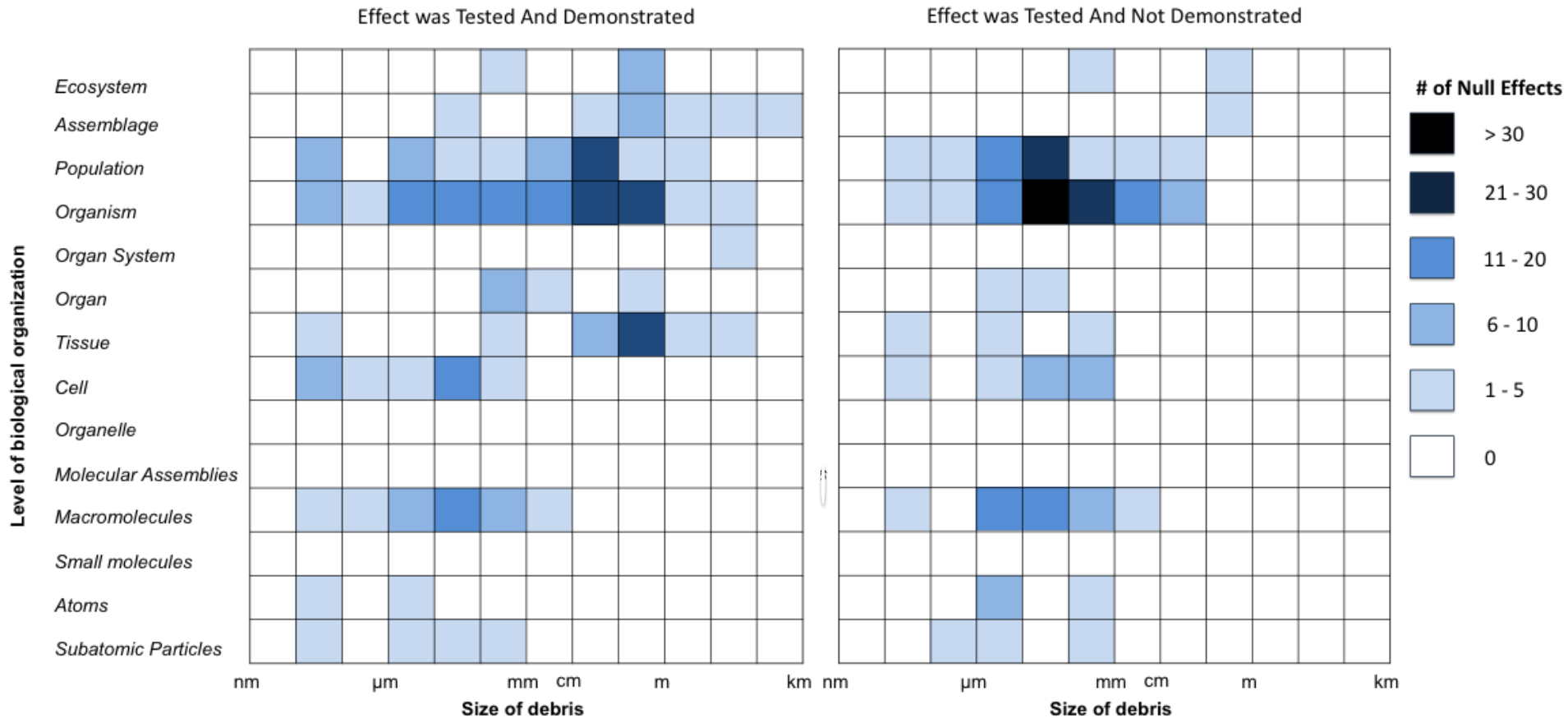
Through 2013



Through 2017

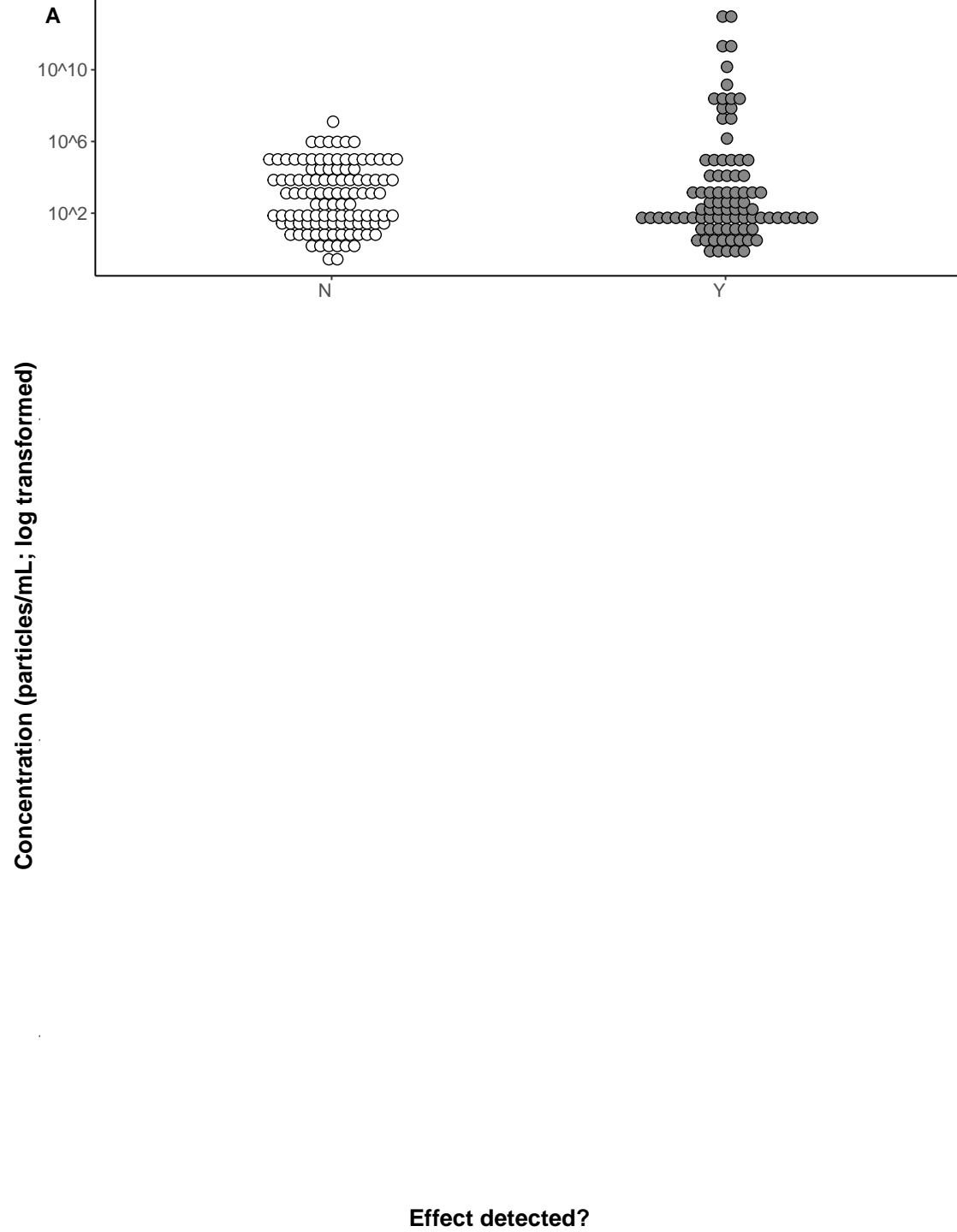


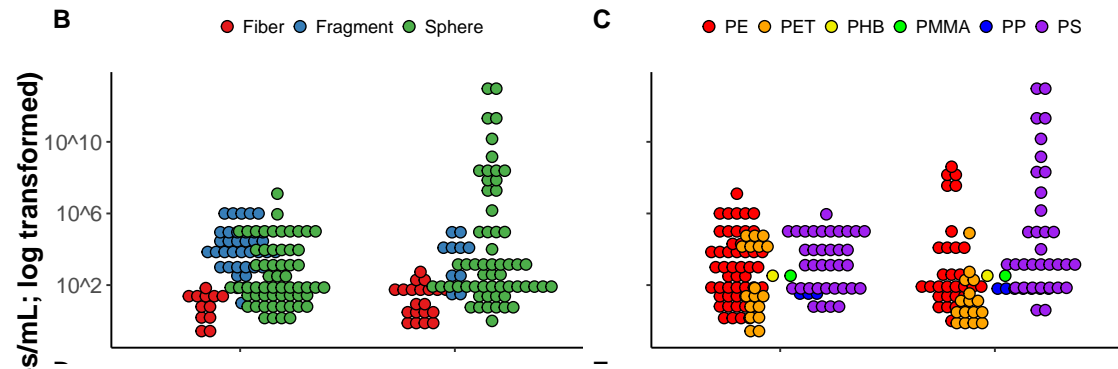
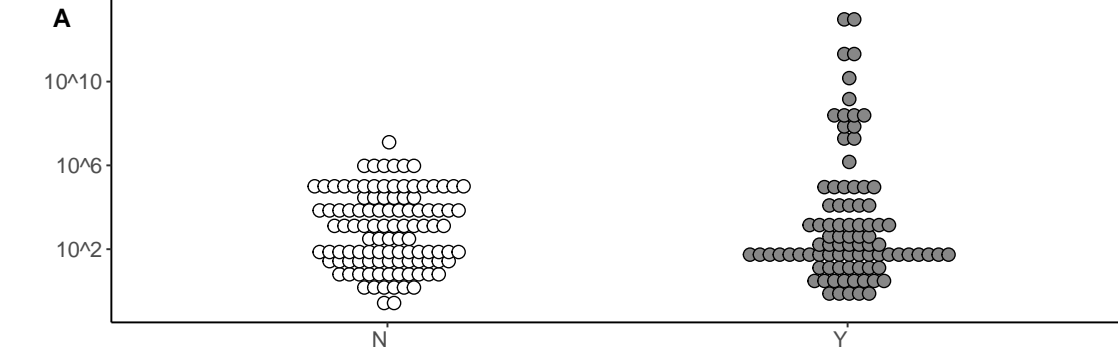
Effect Detected vs Not Detected



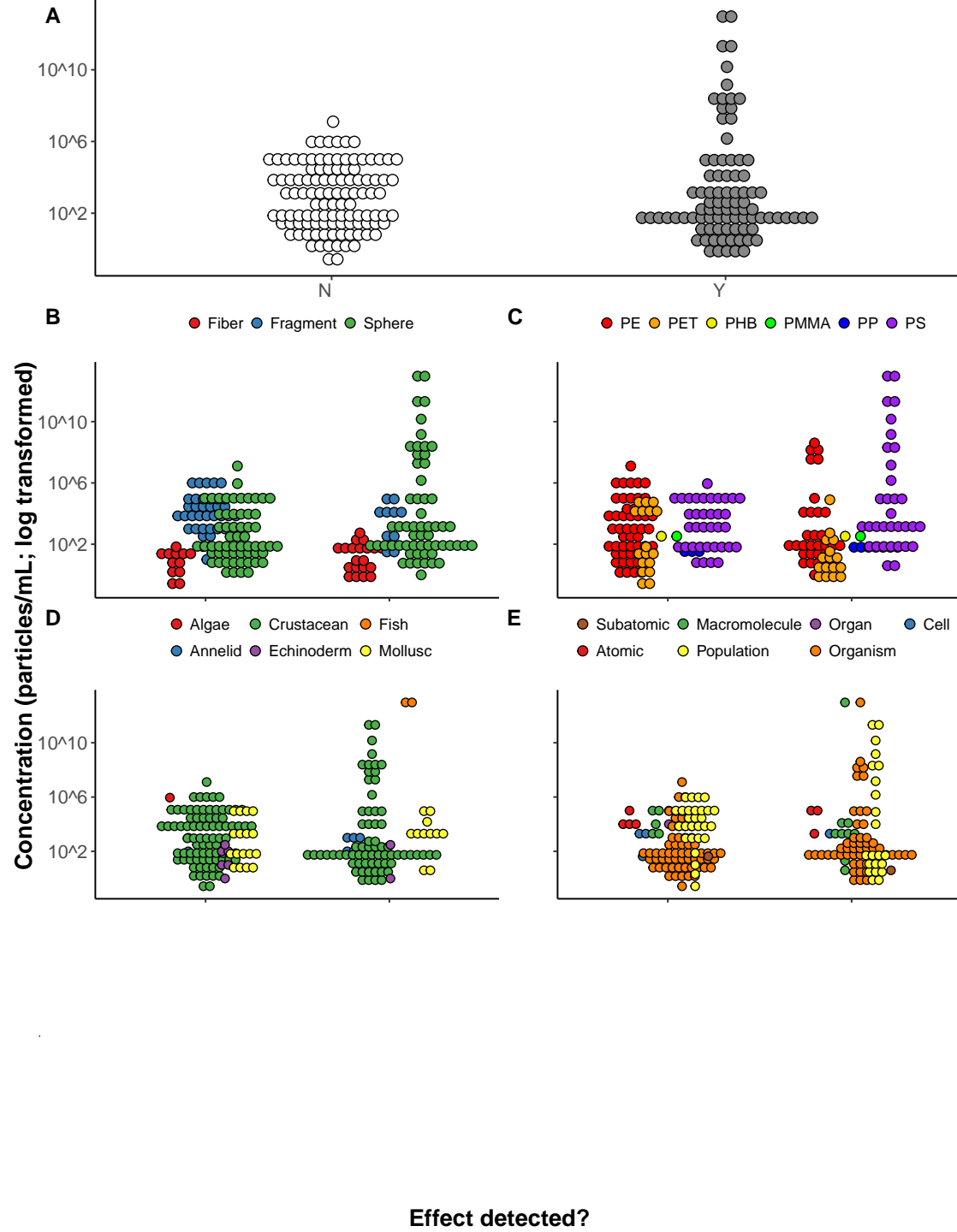
What makes an effect detected vs not detected?

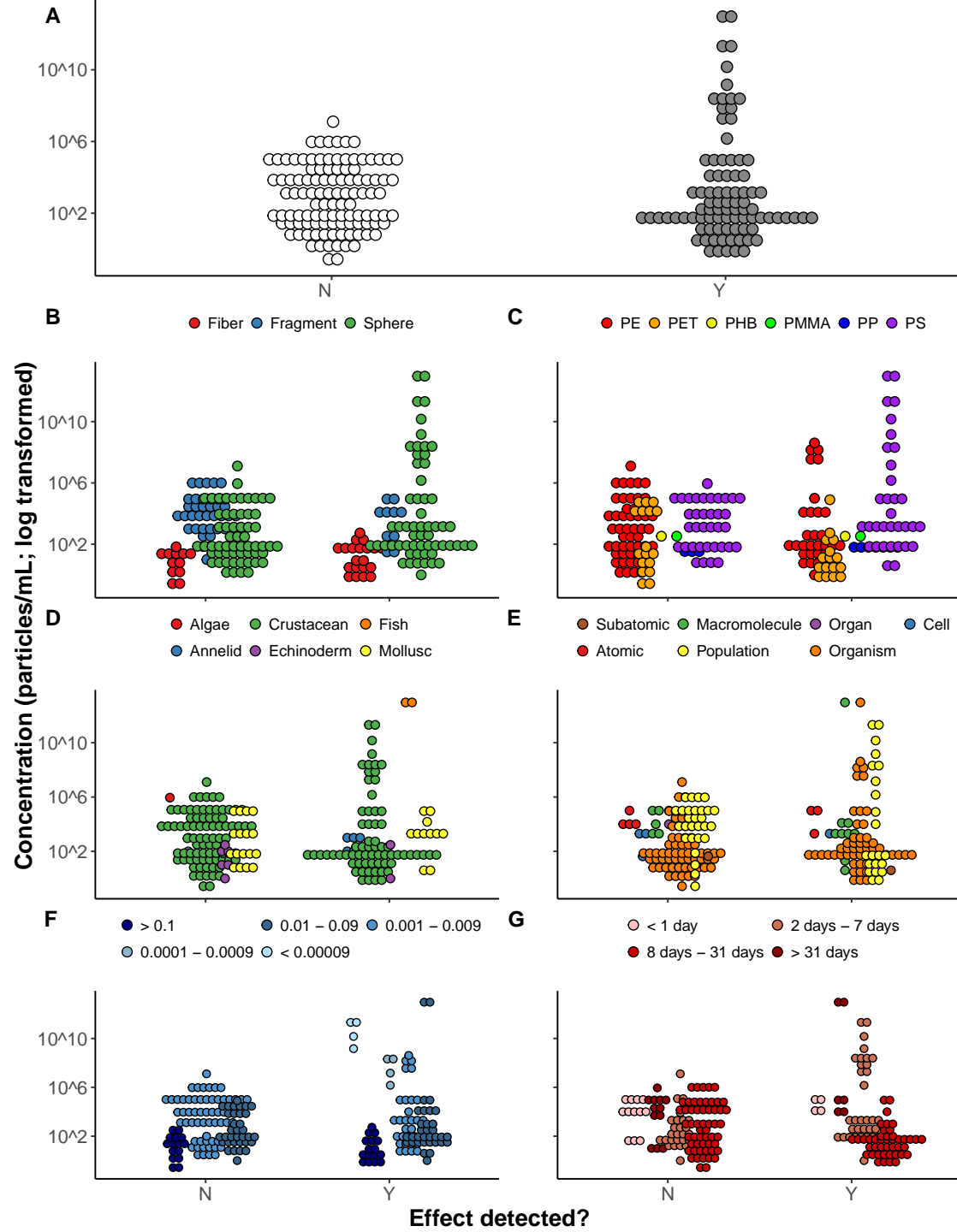
- dose
- shape of microplastic
- type of microplastic
- taxa
- size of microplastic
- experimental design



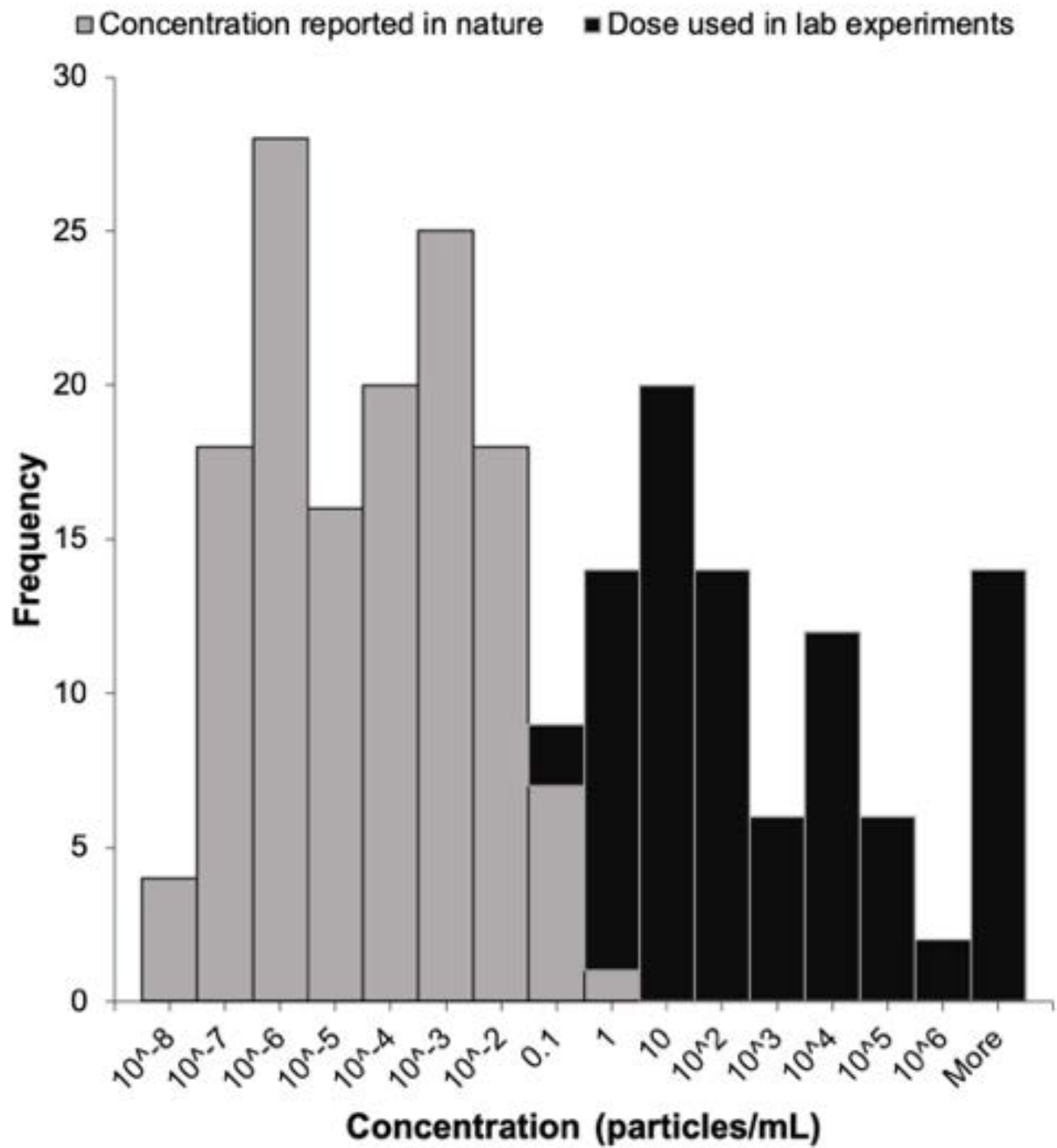


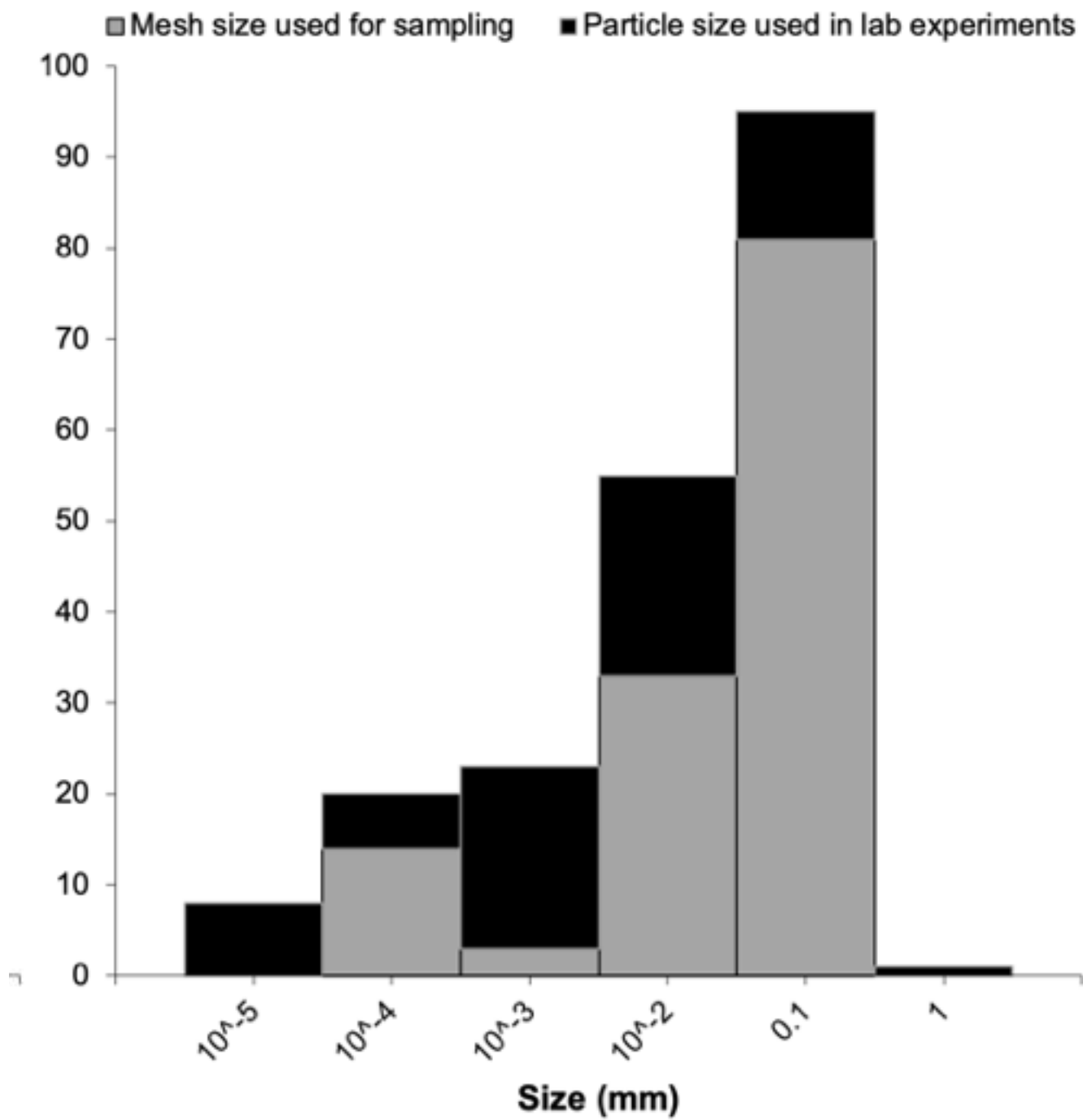
Effect detected?

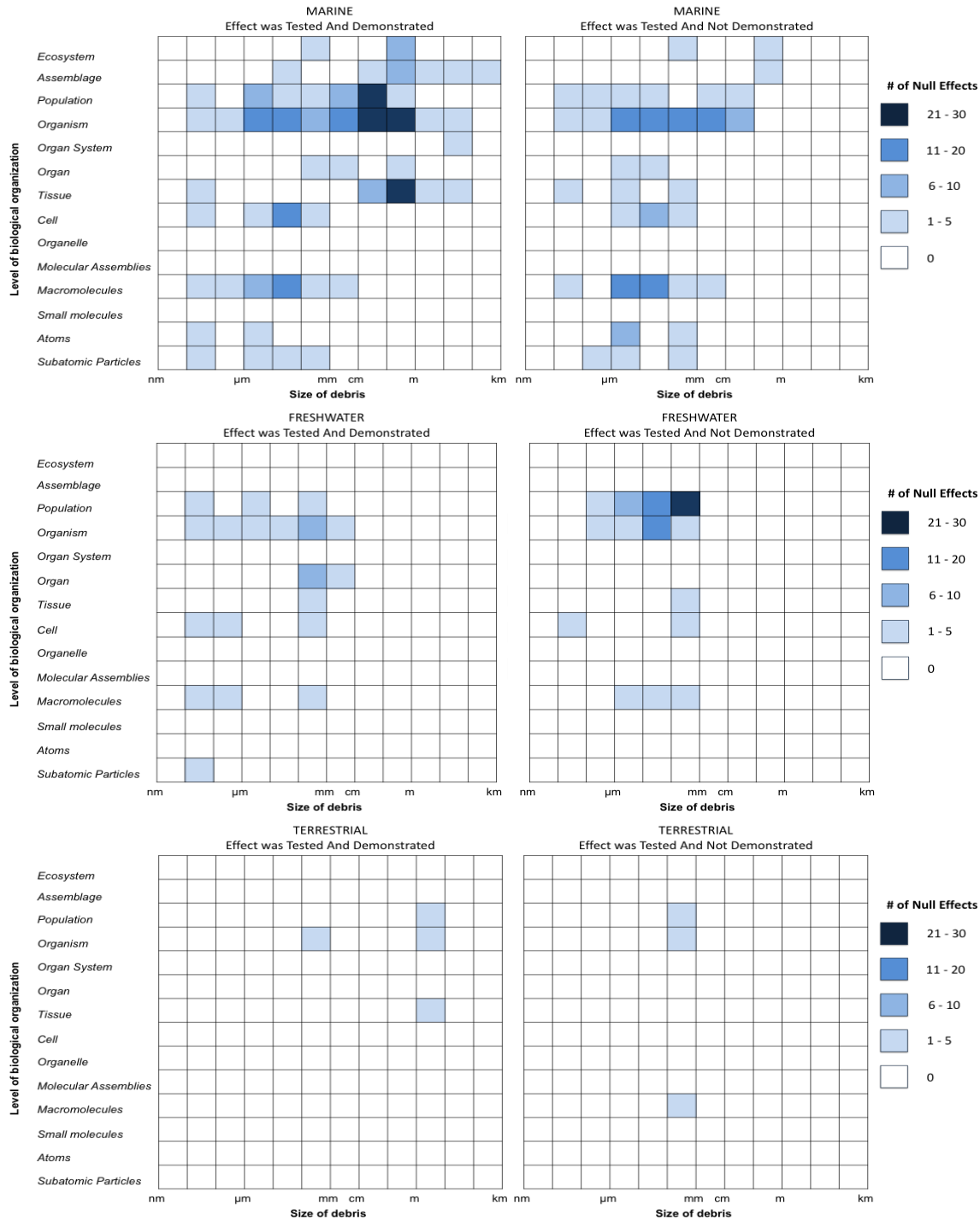




The known and **unknowns** about the effects of plastic pollution on wildlife





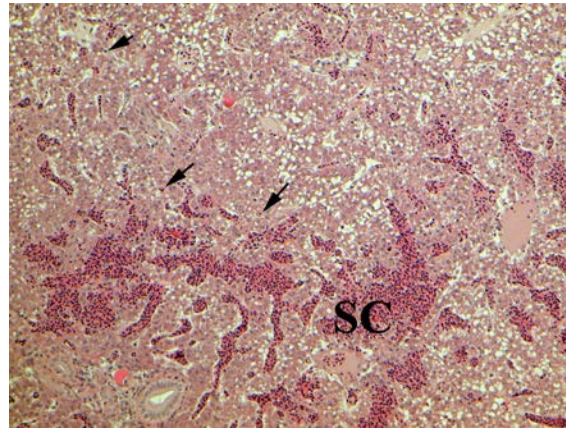
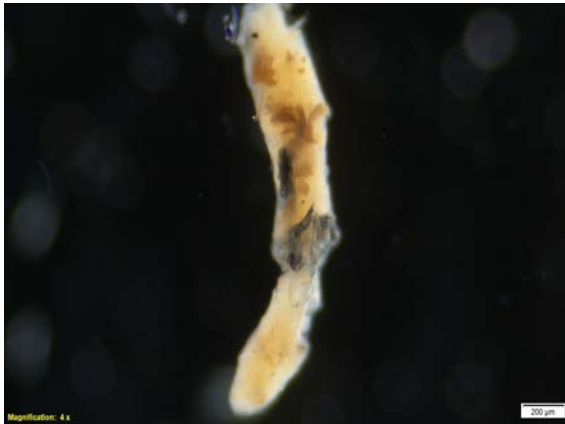
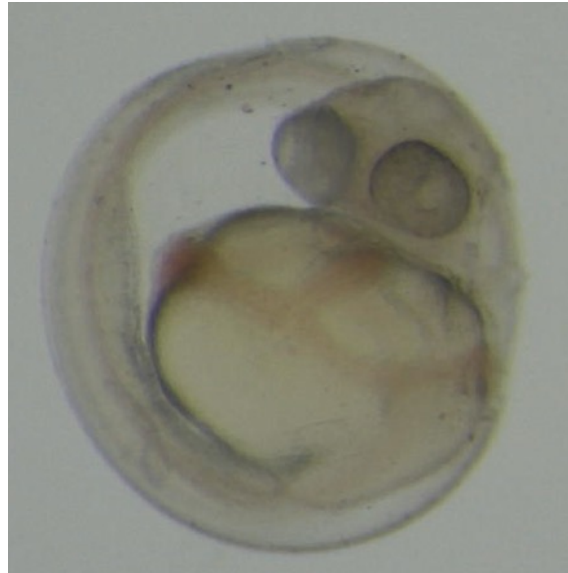


Study	Organism	Effect	Plastic Type	Size	Length of Exposure	Shape	LC50 Concentration
<u>Ogonowski et al., 2016</u>	<i>Daphnia Magna</i>	Death	Unknown (from <u>Cospheric</u>)	4 μm	14 d	Sphere	1 M particles/mL
Au et al., 2015	<i>Hyaella azteca</i>	Death	PP	20-74μm	10 d	Fiber	46,400 particles/mL
	<i>Hyaella azteca</i>	Death	PE	10-27μm	10 d	Fragment	71.43 particle/mL
<u>Frydkejar et al., 2017</u>	<i>Daphnia magna</i>	Immobilization	PE	10-75μm	48 h	Fragment	65 mg/L
<u>Ziajahromi et al., 2017</u>	<i>Ceriodaphnia dubia</i>	Death	PE	1-4μm	48 h	Sphere	2.2 mg/L
	<i>Ceriodaphnia dubia</i>	Death	PE	1-4μm	48 h	Fiber	1.5 mg/L
<u>Rehse et al., 2016</u>	<i>Daphnia magna</i>	Immobilization	PE	1μm	96 h	Sphere	57.42 mg/L
<u>Kim et al., 2017</u>	<i>Daphnia magna</i>	Immobilization	PS	200nm	48 h	Sphere	0.04 mg/L

In Summary:

- There are a lot more studies testing hypotheses about the effects of plastics on organisms.
 - This includes studies testing effects at higher levels of organization.
- For large plastic debris, there is no doubt that plastic harms wildlife. For microplastics, there is evidence that it can cause harm, but when and how is complicated and further work is needed to understand this.
- We need more studies testing hypotheses about microplastics:
 - That recognize their complexity
 - In freshwater and terrestrial environments
 - That help us understand the environmentally relevant effects: more field studies, using relevant concentrations and sizes (includes better measurement in nature)

Thank you!



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